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## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

### APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: ER 1-8429  
SRP Section: Environmental Report  
Application Section: APR1400 Environmental Report  
Date of RAI Issued: 03/22/2016

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### **Question No. EIS ACC/SAMDA-1**

10 CFR 51.55(a) requires each applicant for a standard design certification under subpart B of 10 CFR Part 52 (i.e., 10 CFR 52.47(b)(2)) to submit with its application a separate document entitled, "Applicant's Environmental Report—Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified.

The environmental standard review plan (ESRP) Section 7.3, Severe Accident Mitigation Alternatives, directs the staff to evaluate and independently confirm an applicant's severe accident mitigation design alternatives (SAMDA) analysis presented in an Environmental Report (ER) (i.e., the APR1400 ER, "Applicant's Environmental Report – Standard Design Certification," found under ML15006A038 and the technical report, "Severe Accident Mitigation Design Alternatives (SAMDA) for the APR1400," proprietary under ML15012A105 and nonproprietary under ML15009A246) that applies design and site information along with a cost-benefit analysis based on the guidance provided in NUREG/BR-0184. The scope includes the identification and evaluation of design alternatives and procedural modifications that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident). The purpose of the review is to ensure that plant design changes with the potential for improved severe accident safety performance are identified and evaluated.

The staff requires the following additional information in order to complete its review of the environmental impacts of severe accidents and to ensure appropriate documentation of the applicant's assessment in the APR1400 Environmental Report.

Based on the justifications given in Table 4 under the column heading of Qualitative Screening, there appear to be upward of 39 potentially cost-beneficial SAMDAs. Provide additional documentation in Table 4 of APR1400- E- P- NR- 14006- P with the basis as to why the costs

are excessive or benefits negligible for certain SAMDAs and also clearly identify the specific SAMDAs that were not screened out. Clearly identify which SAMDAs were determined to need additional qualitative screening.

The NRC staff request that any revisions to the ER or supporting technical reports be provided as a markup as part of the response to this RAI.

This RAI is related to the Environmental Audit Information Needs ER-TI-12 (ML15198A023).

## **Response**

Using the recently-updated PRA results, all SAMDA items have been re-evaluated for potential benefit. As part of this analysis, a cross-reference between the section numbers and tables for all potential SAMDA items is provided (see the Qualitative Screening column in Table 5 of the SAMDA Report (APR1400-E-P-NR-14006-P, Rev. 1)).

Because of the extent of the revisions, specific markups are not provided.

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### **Impact on DCD**

There is no impact on the DCD.

### **Impact on PRA**

There is no impact on the PRA.

### **Impact on Technical Specifications**

There is no impact on the Technical Specifications.

### **Impact on Technical/Topical/Environmental Reports**

The Environmental Report and SAMDA Report are updated to reflect the changes discussed above.

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### **Question No. EIS ACC/SAMDA-2**

10 CFR 51.55(a) requires each applicant for a standard design certification under subpart B of 10 CFR Part 52 (i.e., 10 CFR 52.47(b)(2)) to submit with its application a separate document entitled, "Applicant's Environmental Report—Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified.

The environmental standard review plan (ESRP) Section 7.3, Severe Accident Mitigation Alternatives, directs the staff to evaluate and independently confirm an applicant's severe accident mitigation design alternatives (SAMDA) analysis presented in an Environmental Report (ER) (i.e., the APR1400 ER, "Applicant's Environmental Report – Standard Design Certification," found under ML15006A038 and the technical report, "Severe Accident Mitigation Design Alternatives (SAMDA) for the APR1400," proprietary under ML15012A105 and nonproprietary under ML15009A246) that applies design and site information along with a cost-benefit analysis based on the guidance provided in NUREG/BR-0184. The scope includes the identification and evaluation of design alternatives and procedural modifications that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident). The purpose of the review is to ensure that plant design changes with the potential for improved severe accident safety performance are identified and evaluated.

The staff requires the following additional information in order to complete its review of the environmental impacts of severe accidents and to ensure appropriate documentation of the applicant's assessment in the APR1400 Environmental Report.

Provide additional technical justification (i.e., the methodology and the source documents) for inclusion of each basic event discussed in Section 7 of APR1400- E- P- NR- 14006- P as to why they should be considered as SAMDAs. While APR1400- E- P- NR- 14006- P, Section 5,

Identification of SAMDAs, describes the third source used to identify SAMDA items being from an importance analysis of the results from the APR1400 PRA analyses, no references or other documentation is provided. Additionally, while it is stated that each basic event with a Fussell-Vesely importance of greater than 0.5 percent was reviewed to identify any potential SAMDAs, no documentation is provided in the ER or in Section 7 of APR1400- E- P- NR- 14006- P as to why this is appropriate to be applied for certain cutsets used for the importance analysis.

The response to this RAI also may need to be reflected in the DCD's FSAR Chapter 19.

The NRC staff request that any revisions to the ER or supporting technical reports be provided as a markup as part of the response to this RAI.

This RAI is related to the Environmental Audit Information Needs ER-TI-9 and ER-TI-10 (ML15198A023).

### **Response**

Using the recently-updated PRA results, all basic events and SAMDA items have been re-evaluated for potential benefit. As part of this analysis, a cross-reference between the section numbers and tables for all basic event with a Fussell- Vesely importance of greater than 0.5 percent was reviewed to identify any potential SAMDAs, and the cross-references are provided (see Tables 6a to 6f and Tables 7a to 7f of the SAMDA Report (APR1400-E-P-NR-14006-P, Rev. 1). Sections 5 and 6 of the Environmental Report (APR1400-K-X-ER-14001-NP, Rev. 1) have been revised to provide the basis for Section 7 of the Environmental Report.

Additionally, Section 5 of the revised Environmental Report has been updated to include the following statement:

“The ASME PRA Standard (ASME/ANS RA-Sb-2013) defines a significant basic event as a basic event that contributes significantly to the computed risks for a specific hazard group. This definition includes any basic event that has a FV importance greater than 0.005 (0.5%) or a RAW importance greater than 2. The purpose of the SAMDA analysis is to consider ways to reduce risk. The RAW importance parameter does not provide indication of potential risk reduction and is not germane to a SAMDA analysis for risk reduction. Therefore, the RAW importance measure is not used.”

Because of the extent of the revisions, specific markups are not provided.

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### **Impact on DCD**

There is no impact on the DCD.

### **Impact on PRA**

There is no impact on the PRA.

**Impact on Technical Specifications**

There is no impact on the Technical Specifications.

**Impact on Technical/Topical/Environmental Reports**

The Environmental Report and SAMDA Report are updated to reflect the changes discussed above.

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### **Question No. EIS ACC/SAMDA-3**

10 CFR 51.55(a) requires each applicant for a standard design certification under subpart B of 10 CFR Part 52 (i.e., 10 CFR 52.47(b)(2)) to submit with its application a separate document entitled, "Applicant's Environmental Report—Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified.

The environmental standard review plan (ESRP) Section 7.3, Severe Accident Mitigation Alternatives, directs the staff to evaluate and independently confirm an applicant's severe accident mitigation design alternatives (SAMDA) analysis presented in an Environmental Report (ER) (i.e., the APR1400 ER, "Applicant's Environmental Report – Standard Design Certification," found under ML15006A038 and the technical report, "Severe Accident Mitigation Design Alternatives (SAMDA) for the APR1400," proprietary under ML15012A105 and nonproprietary under ML15009A246) that applies design and site information along with a cost-benefit analysis based on the guidance provided in NUREG/BR-0184. The scope includes the identification and evaluation of design alternatives and procedural modifications that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident). The purpose of the review is to ensure that plant design changes with the potential for improved severe accident safety performance are identified and evaluated.

The staff requires the following additional information in order to complete its review of the environmental impacts of severe accidents and to ensure appropriate documentation of the applicant's assessment in the APR1400 Environmental Report.

Provide in the ER or supporting technical reports the baseline implementation cost in U.S. dollars for each SAMDA not screened out in ER Table 4 and for the basic events used to evaluate SAMDA benefit in Section 7 of APR1400- E- P- NR- 14006- P, Rev 0. ER Section 7.1

and 7.2 indicates that important basic events from at- power, and LPSD PRA events were reviewed and assessed for their maximum total benefit along with other events from the top 100 cutsets. However, the baseline cost along with justification for each potentially beneficial SAMDA is not presented in the ER or supporting technical reports. To properly compare the averted cost to the benefit of these potential SAMDAs, or related to important basic events, the specific implementation costs with documentation for each non-screened SAMDA and basic event needs to be provided.

The NRC staff request that any revisions to the ER or supporting technical reports be provided as a markup as part of the response to this RAI.

This RAI is related to the Environmental Audit Information Needs ER-TI-9 and ER-TI-11 (ML15198A023).

### **Response**

Using the recently-updated PRA results, all basic events and SAMDA items have been re-evaluated for potential benefit. Implementation costs and cost-benefit information are detailed in Sections 8 and 9 in the SAMDA Report (APR1400-E-P-NR-14006-P, Rev. 1). The Environmental Report (APR1400-K-X-ER-14001-NP, Rev. 1) was also revised to reflect the changes in the SAMDA report.

Because of the extent of the revisions, specific markups are not provided.

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#### **Impact on DCD**

There is no impact on the DCD.

#### **Impact on PRA**

There is no impact on the PRA.

#### **Impact on Technical Specifications**

There is no impact on the Technical Specifications.

#### **Impact on Technical/Topical/Environmental Reports**

The Environmental Report and SAMDA Report are updated to reflect the changes discussed above.

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## RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

### APR1400 Design Certification

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### **Question No. EIS ACC/SAMDA-6**

10 CFR 51.55(a) requires each applicant for a standard design certification under subpart B of 10 CFR Part 52 (i.e., 10 CFR 52.47(b)(2)) to submit with its application a separate document entitled, "Applicant's Environmental Report—Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified.

The environmental standard review plan (ESRP) Section 7.3, Severe Accident Mitigation Alternatives, directs the staff to evaluate and independently confirm an applicant's severe accident mitigation design alternatives (SAMDA) analysis presented in an Environmental Report (ER) (i.e., the APR1400 ER, "Applicant's Environmental Report – Standard Design Certification," found under ML15006A038 and the technical report, "Severe Accident Mitigation Design Alternatives (SAMDA) for the APR1400," proprietary under ML15012A105 and nonproprietary under ML15009A246) that applies design and site information along with a cost-benefit analysis based on the guidance provided in NUREG/BR-0184. The scope includes the identification and evaluation of design alternatives and procedural modifications that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident). The purpose of the review is to ensure that plant design changes with the potential for improved severe accident safety performance are identified and evaluated.

The staff requires the following additional information in order to complete its review of the environmental impacts of severe accidents and to ensure appropriate documentation of the applicant's assessment in the APR1400 Environmental Report.

Provide the source document(s) and the pages in these documents for the approximately 540 SAMDA items from the PRA results. Section 5 of the ER and APR1400-E - P - NR - 14006 - P mentioned the PRA for APR1400 as the third information source used to identify SAMDA items.

However, no references are provided in Section 5 and in Tables 5a through 5f as to which PRA documents is the source for this information.

The NRC staff request that any revisions to the ER or supporting technical reports be provided as a markup as part of the response to this RAI.

This RAI is related to the Environmental Audit Information Needs ER-COM-4 (ML15198A023).

## **Response**

Section 5 of the SAMDA Report (APR1400-E-P-NR-14006-P, Rev. 1) was updated to identify the source of the SAMDA items and reads as follows:

“Each basic event with a Fussell-Vesely importance of greater than 0.5%, a total of 126 basic events for At-Power internal events (Reference 5 – Table 19.1-21), 110 for At-Power internal flooding events (Reference 5 – Table 19.1-69), 120 for At-Power fire events (Reference 5 – Table 19.1-52), 79 for LPSD internal events (Reference 5 – Table 19.1-100), 75 for LPSD internal flooding events (Reference 5 – Table 19.1-113), and 98 for LPSD fire events (Reference 5 – Table 19.1-126), were reviewed to identify any potential SAMDAs. Basic events, such as or constants, have no physical meaning are identified and can be excluded as having no impact on the SAMDA analysis. A listing of the basic events, their importance, and their disposition with respect to SAMDA items is given in Tables 6a through 6f.

In addition to the basic event importance review, the top 100 cutsets for each analysis were reviewed to identify any basic events that were not included as part of the importance analysis review. Basic events identified in the top 100 cutsets that are not included as part of the importance analysis review are shown in Tables 7a through 7f. The top 100 cutsets for At-Power internal events are taken from Reference 5 – Table 19.1-19. The top 100 cutsets for At-Power internal flooding are taken from Reference 5 – Table 19.1-66. The top 100 cutsets for At-Power internal fire are taken from Reference 5 – Table 19.1-49. The top 100 cutsets for LPSD internal events are taken from Reference 5 – Table 19.1-96. The top 100 cutsets for LPSD internal flooding are taken from Reference 5 – Table 19.1-109. The top 100 cutsets for LPSD internal fires are taken from Reference 5 – Table 19.1-122.”

Reference 5 above is APR1400-K-X-FS-14002-P, Revision 1A, “APR1400 Design Control Document Tier 2, Chapter 19, Probabilistic Risk Assessment and Severe Accident Evaluation.”

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### **Impact on DCD**

There is no impact on the DCD.

### **Impact on PRA**

There is no impact on the PRA.

### **Impact on Technical Specifications**

There is no impact on the Technical Specifications.

**Impact on Technical/Topical/Environmental Reports**

The SAMDA report is updated to reflect the above changes.

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### **Question No. EIS ACC/SAMDA-8**

10 CFR 51.55(a) requires each applicant for a standard design certification under subpart B of 10 CFR Part 52 (i.e., 10 CFR 52.47(b)(2)) to submit with its application a separate document entitled, "Applicant's Environmental Report—Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design to be certified.

The environmental standard review plan (ESRP) Section 7.3, Severe Accident Mitigation Alternatives, directs the staff to evaluate and independently confirm an applicant's severe accident mitigation design alternatives (SAMDA) analysis presented in an Environmental Report (ER) (i.e., the APR1400 ER, "Applicant's Environmental Report – Standard Design Certification," found under ML15006A038 and the technical report, "Severe Accident Mitigation Design Alternatives (SAMDA) for the APR1400," proprietary under ML15012A105 and nonproprietary under ML15009A246) that applies design and site information along with a cost-benefit analysis based on the guidance provided in NUREG/BR-0184. The scope includes the identification and evaluation of design alternatives and procedural modifications that reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment in the event that substantial core damage occurs (i.e., mitigating the impacts of a severe accident). The purpose of the review is to ensure that plant design changes with the potential for improved severe accident safety performance are identified and evaluated.

The staff requires the following additional information in order to complete its review of the environmental impacts of severe accidents and to ensure appropriate documentation of the applicant's assessment in the APR1400 Environmental Report.

Describe how and whether the ER and SAMDA analysis will be updated to reflect changes to plant systems, configurations, and the APR1400 design. Specify how the ER and SAMDA

analysis will be updated to reflect subsequent information developed during the DC review (i.e., updates to the APR1400 DCD and PRA information and insights).

### **Response**

The PRA models for all hazards have been updated during 2017. 2017 PRA update incorporates changes to plant systems and design along with other changes and required corrections identified during the RAI process.

The SAMDA Report has been completely re-evaluated using the results of 2017 PRA update. See APR1400-E-P-NR-014006-P, Rev. 1.

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### **Impact on DCD**

No changes to the DCD are required.

### **Impact on PRA**

There is no impact on the PRA.

### **Impact on Technical Specifications**

There is no impact on the Technical Specifications.

### **Impact on Technical/Topical/Environmental Reports**

The Environmental Report and SAMDA Report are updated to reflect the results of the PRA update.